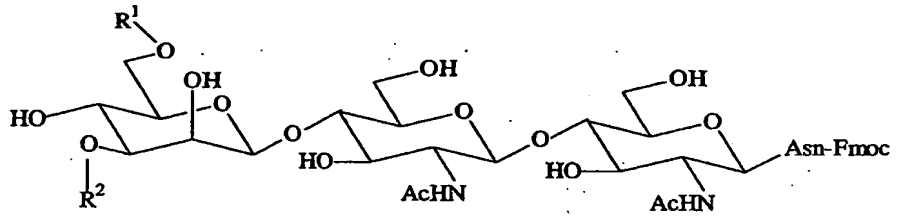
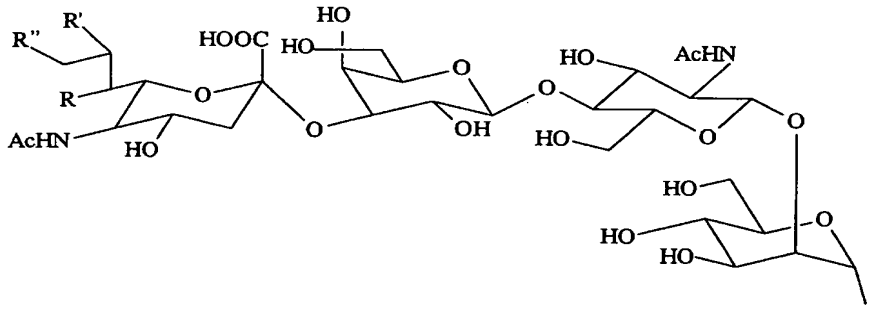
CLAIMS

1. An asparagine-linked α2,3-oligosaccharide derivative having undeca- to hepta-saccharides and represented by the formula (1) given below



(1)

wherein R^1 and R^2 are each a hydrogen atom or one of the groups represented by the formulae (2) to (5) and may be the same or different, provided that one of R^1 and R^2 should always be the group of the formula (2).



(2)

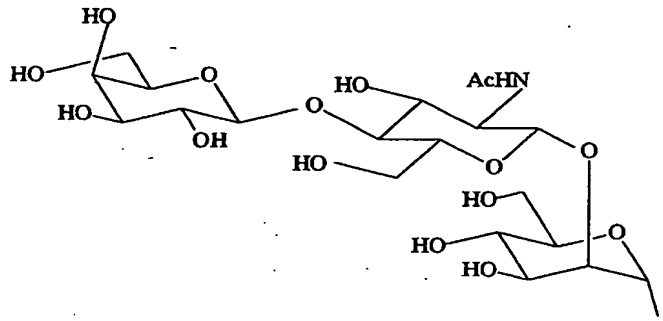
R, R' and R" are in the following combinations

(a) R=F, R'=OH, R"=OH

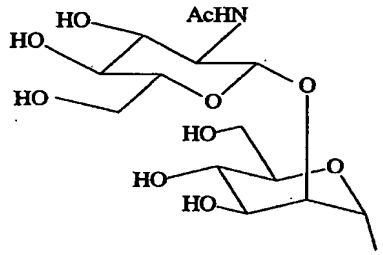
(b) R=OH, R'=F, R"=OH

(c) R=OH, R'=OH, R"=F

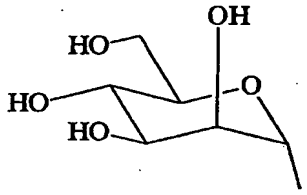
(d) R=OH, R'=OH, R"=OH



(3)

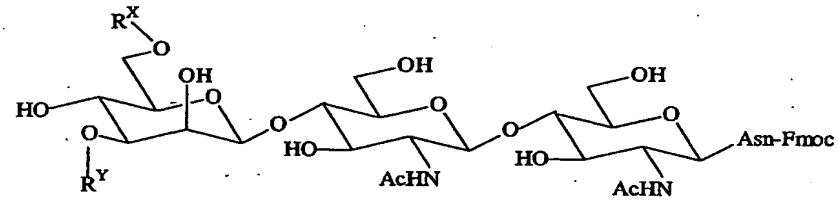


(4)



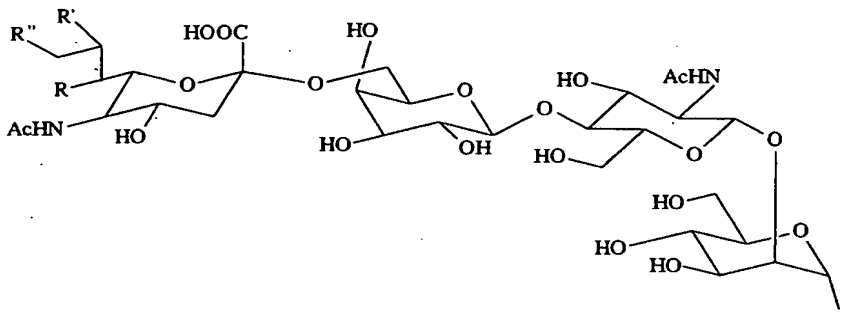
(5)

2. An asparagine-linked α2,6-oligosaccharide derivative having undeca- to hepta-saccharides, containing fluorine and represented by the formula (6) given below



(6)

wherein R^x and R^y are each a hydrogen atom, a group represented by the formula (7) or one of the groups represented by the formulae (3) to (5), provided that one of R^x and R^y should always be a group of the formula (7).



(7)

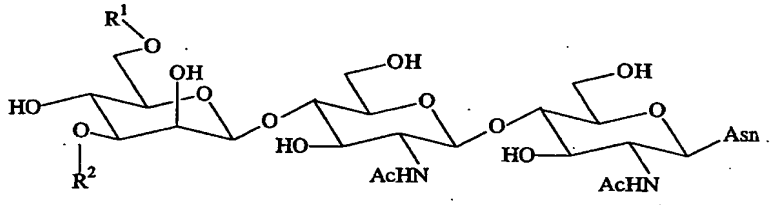
R, R' and R" are in the following combinations

(a) R=F, R'=OH, R"=OH

(b) R=OH, R'=F, R"=OH

(c) R=OH, R'=OH, R"=F

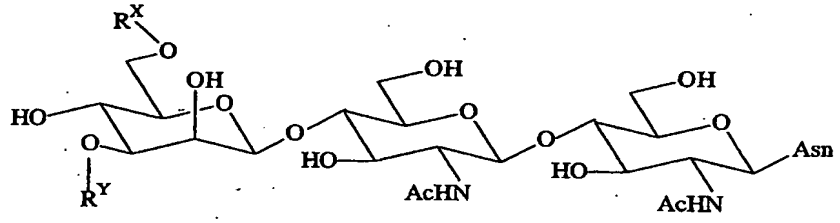
3. An asparagine-linked α2,3-oligosaccharide having undeca- to hepta-saccharides and represented by the formula (8) given below



(8)

wherein R^1 and R^2 are as defined above.

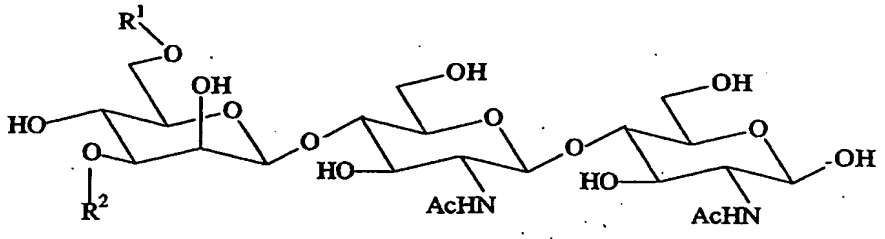
4. An asparagine-linked α2,6-oligosaccharide having undeca- to hepta-saccharides, containing fluorine and represented by the formula (9) given below



(9)

wherein R^x and R^y are as defined above.

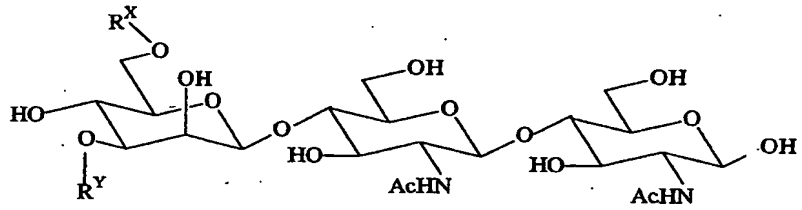
5. An α2,3-oligosaccharide having undeca- to hepta-saccharides and represented by the formula (10) given below



(10)

wherein R^1 and R^2 are as defined above.

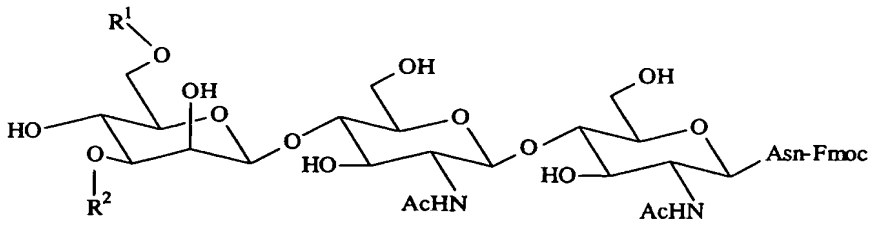
6. An α2,6-oligosaccharide having undeca- to hepta-saccharides, containing fluorine and represented by the formula (11) given below



(11)

wherein R^x and R^y are as defined above.

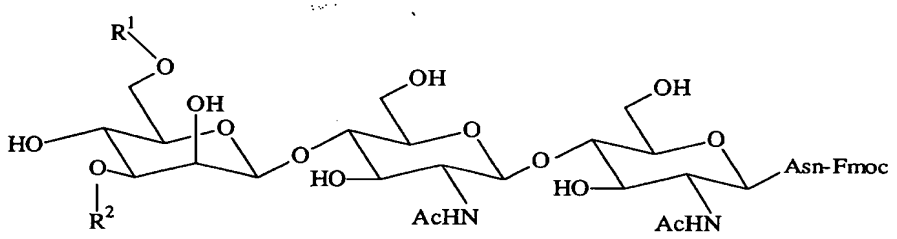
7. A process for preparing an asparagine-linked α2,3-disialooligosaccharide derivative having undecasaccharide and represented by the formula (12) given below, the process being characterized by transferring sialic acid or a sialic acid derivative to an asparagine-linked oligosaccharide protected with a lipophilic protective group using a sialic acid transferase, and subjecting the resulting asparagine-linked oligosaccharide protected with a lipophilic protective group to chromatography for separation



(12)

wherein R^1 and R^2 are each a group represented by the formula (2).

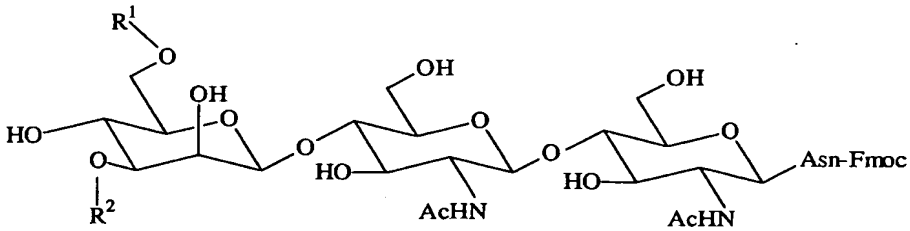
8. A process for preparing an asparagine-linked α2,3-monosialooligosaccharide derivative having decasaccharide and represented by the formula (13) given below, the process being characterized by transferring sialic acid or a sialic acid derivative to an asparagine-linked oligosaccharide protected with a lipophilic protective group using a sialic acid transferase, and subjecting the resulting asparagine-linked oligosaccharide protected with a lipophilic protective group to chromatography for separation



(13)

wherein one of R^1 and R^2 is a group represented by the formula (2), and the other thereof is a group represented by the formula (3).

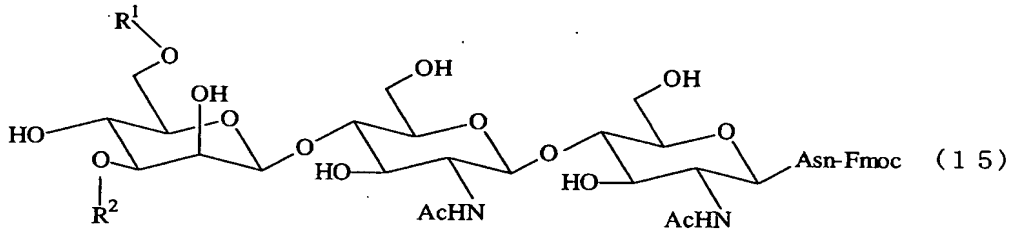
9. A process for preparing an asparagine-linked α2,3-monosialooligosaccharide derivative having nonasaccharide and represented by the formula (14) given below, the process being characterized by hydrolyzing an asparagine-linked monosialooligosaccharide derivative represented by the formula (13) using a galctosidase



(14)

wherein one of R^1 and R^2 is a group represented by the formula (2), and the other thereof is a group represented by the formula (4).

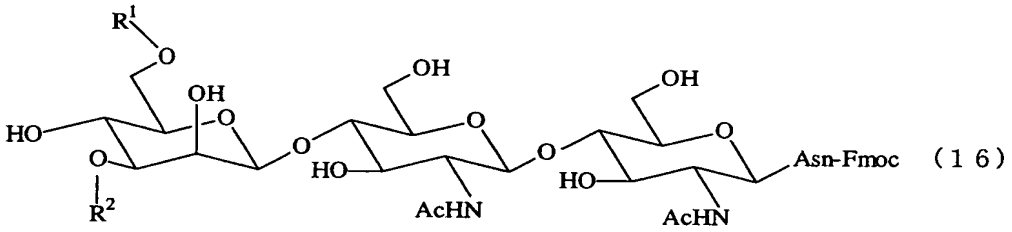
10. A process for preparing an asparagine-linked α2,3-monosialooligosaccharide derivative having octasaccharide and represented by the formula (15) given below, the process being characterized by hydrolyzing an asparagine-linked monosialooligosaccharide derivative represented by the formula (14) using an N-acetylglucosaminidase



(15)

wherein one of R^1 and R^2 is a group represented by the formula (2), and the other thereof is a group represented by the formula (5).

11. A process for preparing an asparagine-linked α2,3-monosialooligosaccharide derivative having heptasaccharide and represented by the formula (16) given below, the process being characterized by hydrolyzing an asparagine-linked monosialooligosaccharide derivative represented by the formula (15) using a mannosidase

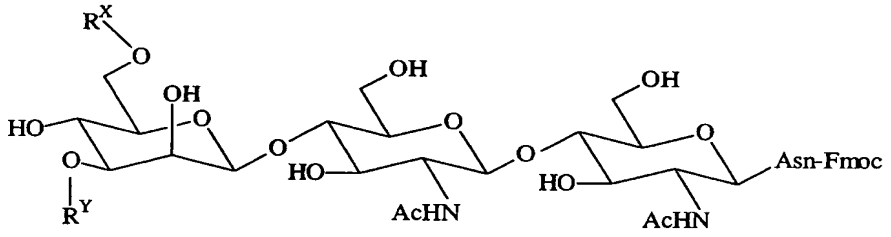


(16)

wherein one of R^1 and R^2 is a group represented by the formula (2), and the other thereof is a hydrogen atom.

12. A process for preparing an asparagine-linked α2,6-

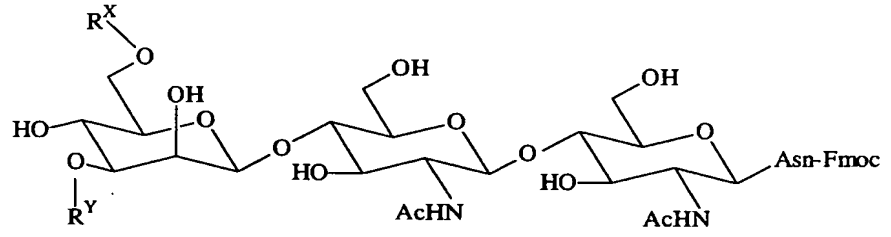
disialooligosaccharide derivative having undecasaccharide and represented by the formula (17) given below, the process being characterized by transferring sialic acid or a sialic acid derivative to an asparagine-linked oligosaccharide protected with a lipophilic protective group using a sialic acid transferase, and subjecting the resulting asparagine-linked oligosaccharide protected with a lipophilic protective group to chromatography for separation



(17)

wherein R^x and R^y are each a group represented by the formula (7).

13. A process for preparing an asparagine-linked α2,6-monosialooligosaccharide derivative having decasaccharide and represented by the formula (18) given below, the process being characterized by transferring sialic acid or a sialic acid derivative to an asparagine-linked oligosaccharide protected with a lipophilic protective group using a sialic acid transferase, and subjecting the resulting asparagine-linked oligosaccharide protected with a lipophilic protective group to chromatography for separation

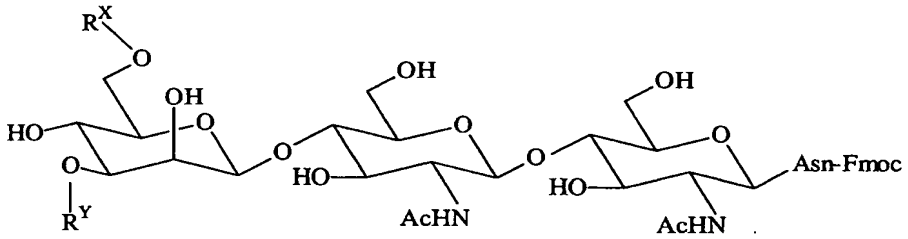


(18)

wherein one of R^x and R^y is a group represented by the formula (7),

and the other thereof is a group represented by the formula (3).

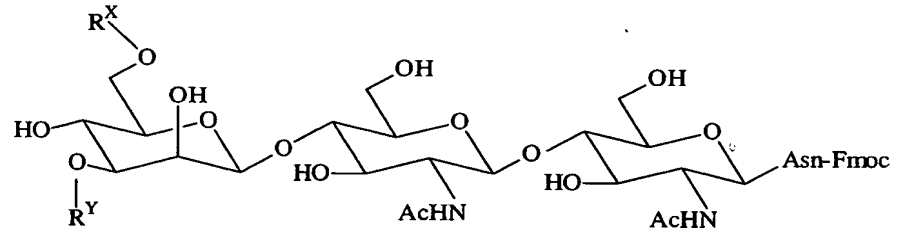
14. A process for preparing an asparagine-linked α2,6-monosialooligosaccharide derivative having nonasaccharide and represented by the formula (19) given below, the process being characterized by hydrolyzing an asparagine-linked monosialooligosaccharide derivative represented by the formula (18) using a galactosidase



(19)

wherein one of R^x and R^y is a group represented by the formula (7), and the other thereof is a group represented by the formula (4).

15. A process for preparing an asparagine-linked α2,6-monosialooligosaccharide derivative having octasaccharide and represented by the formula (20) given below, the process being characterized by hydrolyzing an asparagine-linked monosialooligosaccharide derivative represented by the formula (19) using an N-acetylglucosaminidase

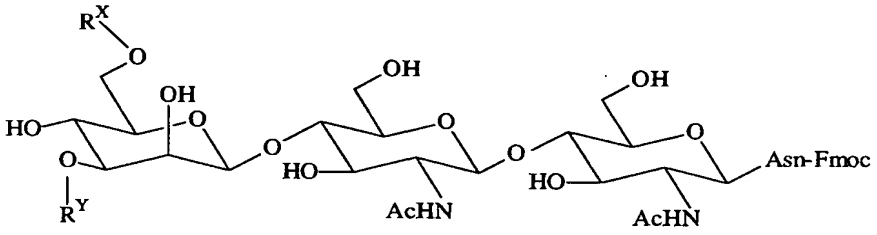


(20)

wherein one of R^x and R^y is a group represented by the formula (7), and the other thereof is a group represented by the formula (5).

16. A process for preparing an asparagine-linked α2,6-

monosialooligosaccharide derivative having heptasaccharide and represented by the formula (21) given below, the process being characterized by hydrolyzing an asparagine-linked monosialooligosaccharide derivative represented by the formula (20) using a mannosidase



(21)

wherein one of R^x and R^y is a group represented by the formula (7), and the other thereof is a hydrogen atom.

17. A process for preparing an aspareagine-linked α2,3-oligosaccharide having undeca- to hepta-saccharides and represented by the formula (8), the process being characterized by removing the protective group from an asparagine-liked α2,3-oligosaccharide derivative having undeca- to hepta-saccharides and represented by the formula (1).

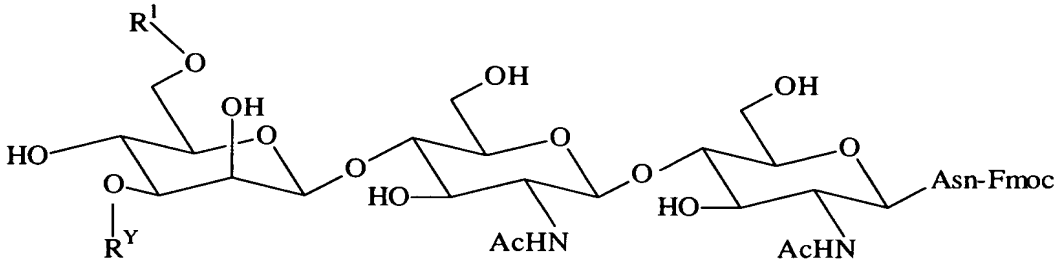
18. A process for preparing an aspareagine-linked α2,6-oligosaccharide having undeca- to hepta-saccharides and represented by the formula (9), the process being characterized by removing the protective group from an asparagine-liked α2,6-oligosaccharide derivative having undeca- to hepta-saccharides and represented by the formula (6).

19. A process for preparing an α2,3-oligosaccharide having undeca- to hepta-saccharides and represented by the formula (10), the process being characterized by removing the asparagine residue

from an asparagine-liked α2,3-oligosaccharide having undeca- to hepta-saccharides and represented by the formula (8).

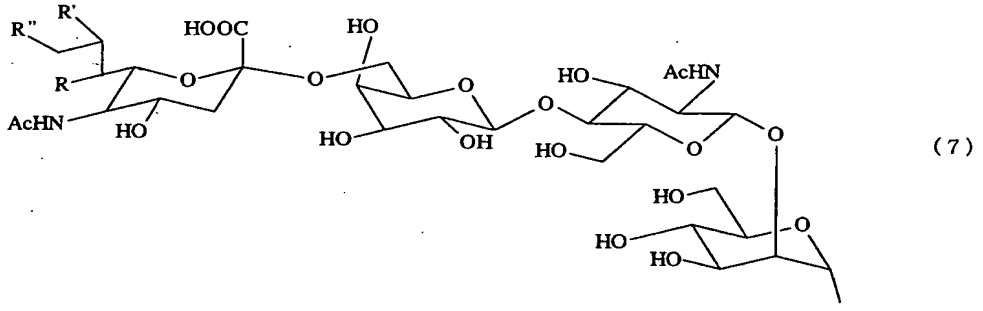
20. A process for preparing an α2,6-oligosaccharide having undeca- to hepta-saccharides and represented by the formula (11), the process being characterized by removing the asparagine residue from an asparagine-liked α2,6-oligosaccharide having undeca- to hepta-saccharides and represented by the formula (9).

21. An asparagine-linked (α2,3) (α2,6)-oligosaccharide derivative having undecasaccharides and represented by the formula (22) given below



(22)

wherein R^1 is a group represented by the formula (2), R^Y is a group represented by the formula (7) below.



(7)

R, R' and R" are in the following combinations

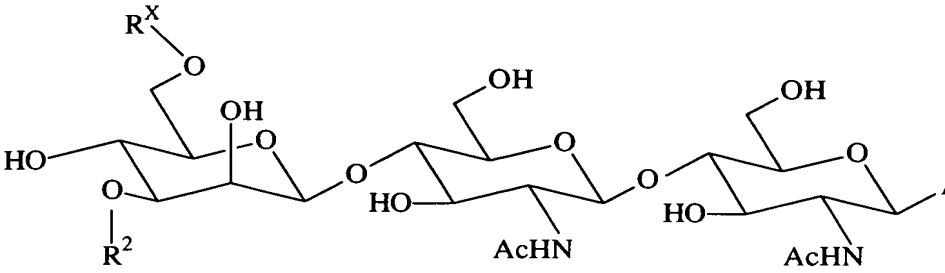
(a) R=F, R'=OH, R"=OH

(b) R=OH, R'=F, R"=OH

(c) R=OH, R'=OH, R"=F

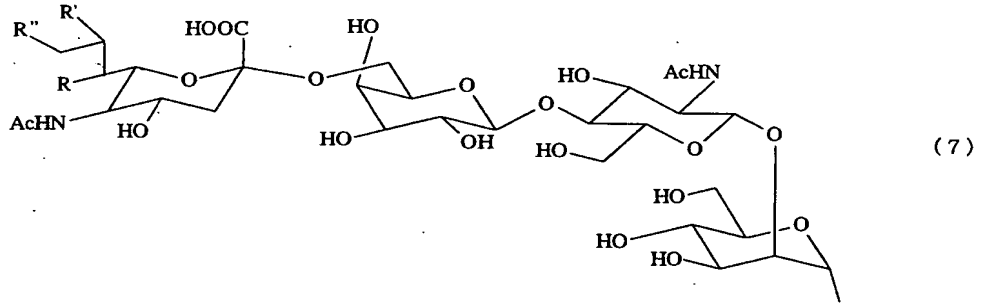
(d) R=OH, R'=OH, R"=OH

22. An asparagine-linked (α2,3) (α2,6)-oligosaccharide derivative having undecasaccharides and represented by the formula (23) given below



(23)

wherein R^2 is a group represented by the formula (2), R^x is a group represented by the formula (7) below.



(7)

R, R' and R" are in the following combinations

(a) R=F, R'=OH, R"=OH

(b) R=OH, R'=F, R"=OH

(c) R=OH, R'=OH, R"=F

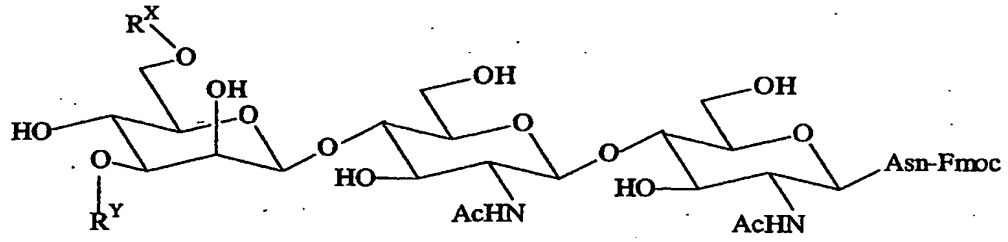
(d) R=OH, R'=OH, R"=OH

23. An asparagine-linked oligosaccharide derivative containing at least one fucose in N-acetylglucosamine on the nonreducing terminal side of an asparagine-linked oligosaccharide wherein the asparagine has amino group protected with a lipophilic protective group.

24. A fucose-containing asparagine-linked oligosaccharide derivative according to claim 23 wherein the asparagine-linked oligosaccharide having the protected amino group in the asparagine thereof with a lipophilic protective group is an asparagine-linked α2,3-oligosaccharide having undeca- to hepta-saccharides and represented by the formula (1).

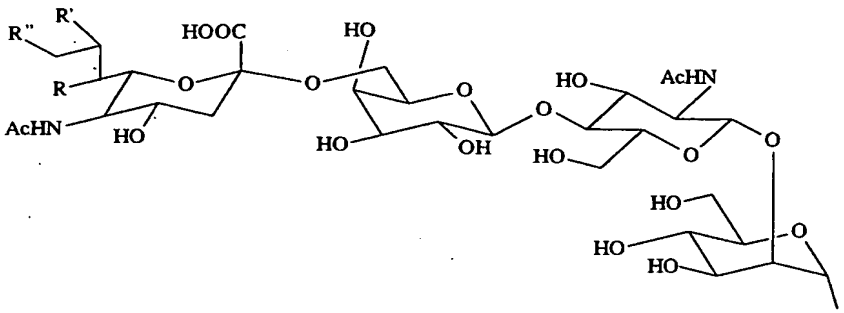
25. A fucose-containing asparagine-linked oligosaccharide derivative according to claim 23 wherein the asparagine-linked oligosaccharide having the protected amino group in the asparagine thereof with a lipophilic protective group is an asparagine-linked α2,6-oligosaccharide having undeca- to hepta-saccharides, containing fluorine and represented by the formula (6).

26. A fucose-containing asparagine-linked oligosaccharide derivative according to claim 23 wherein the asparagine-linked oligosaccharide having the protected amino group in the asparagine thereof with a lipophilic protective group is an asparagine-linked α2,6-oligosaccharide having undeca- to hexa-saccharides and represented by the formula (6)



(6)

wherein R^x and R^y are each a hydrogen atom, a group represented by the formula (7) or one of the groups represented by the formulae (3) to (5), provided that one of R^x and R^y should always be a group of the formula (7) or (3)



(7)

where R = OH, R' = OH and R" = oH.

27. A process for preparing an asparagine-linked oligosaccharide derivative containing at least one fucose in N-acetylglucosamine on the nonreducing terminal side of an asparagine-linked oligosaccharide wherein the asparagine has amino group protected with a lipophilic protective group, the process being characterized by transferring fucose to the asparagine-linked oligosaccharide wherein the asparagine has the protected amino group with a lipophilic protective group using a fucosyl transferase, and subjecting the resulting asparagine-linked oligosaccharide protected with the lipophilic protective group to chromatography for separation.